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The Development of Symplocarpus fœtidus (L.), Salisb.

By Aug. F. Foerste.

Plate LXXXII.

Among the most interesting studies in animal or vegetable morphology are the homologies of aborted or almost obsolete organs which once had a purpose, but now are cast aside as entirely useless. Although the existence of such organs in vegetable life is not so much a matter of general information, it is here that some of the most curious and readily understood examples are to be found.

It has already been noted that *Apios tuberosa** rejects entirely the terminal part of each panicle, and all but the lower two or three buds of each of the remaining racemes, using the scars left by the rejected buds as nectar-glands. Usually, however, rejection does not take place in this literal fashion, but consists merely in a decrease of size and loss of function. Thus in *Symplocarpus fœtidus* † most of the "flowers" are aborted, only a few of the earlier formed developing to maturity. Which shall be the flowers of the next season is already evident during the previous summer. ‡ As many as three or four flowers may blossom in the spring. Since at this time of the year the comparative morphology of the plant is most readily studied, the following notes may be considered as referring chiefly to plants as they appear in the spring:

The outer covering of the growing portion consists of two or three large enfolding scales representing petioles; these are very much decayed. Under favorable conditions small aborted membranaceous spathes may be detected apparently in the axils of

* Bulletin, XI., 1884, p. 123.
† Am. Nat., 1883, p. 1109.
‡ Am. Nat., 1885, p. 301.

alternate scales. These, however, are frequently absent, probably having been decomposed. Following these are healthy scales untainted by decay, the later forms of which develop at their tip, more or less gradually, small leaf-blades, which increase in size in succeeding scales until the normal leaf-form is attained (figs. 6, 7, 8). Apparently in the alternate axils of these scales are from one to four fully developed flowers (fig. 5), succeeding which in regular order are only aborted flowers, apparently in alternate axils of the later scales and in the alternate axils of all true leaves (figs. 9, 10), until a few scales have been formed to serve as an external covering for next spring, when again a few flowers will develop to full maturity. It was stated that one or two aborted flowers produced previously to those which develop normally are membranaceous; the same is true of the first two or three aborted flowers succeeding those of normal development. The remaining aborted flowers cannot at this season of the year be distinguished from those which shall develop in the succeeding season (figs. 16, 17).

Examining these specimens a second time more carefully, it will be found that the flowers are not in the axils of leaves or scales, as at first supposed, this place being occupied by a small leaf bud (fig. 13). These leaf buds are quite small, even in the earlier scales, and decrease rapidly in size until finally they can be detected only by the expert dissector (fig. 17). In this they offer a marked contrast to the flower, which can readily be seen even in the aborted state, long after the detection of the leaf buds has become difficult. The flowers, on the other hand, will now be seen to be situated towards the right or left of the leaf bud (their position being variable in different plants, but continuous for the same specimen), and to be enfolded by the basal edges of a scale, whose axil is on the opposite side of the plant, and never subtends a bud; so that there are alternately scales (or leaves) with and without leaf buds. The flowers are in the axils of neither scales nor leaves.

At this point, when everything seems to be in confusion, all the materials are at hand for the ready understanding of the structure of this plant. The flower in each case represents the end of the entire stem, to which all succeeding parts are but

axial in position. The scale or leaf in whose axil the flower at first seemed to be, is but the first leaf on the stem represented by the flower. The scale or leaf, the basal part of whose lateral edges slightly enfold the flower, is the second leaf of this stem, in whose axil all the succeeding growth of the stem is but a bud which has never been arrested in its development. The spathe of the flower is the third leaf of this axis, and a second spathe which is occasionally present is the fourth leaf. Both the buds which are arrested and those which are not arrested in development are alike in the fact that the first leaf of the new axis is always opposed to the subtending leaf in whose axil they are found (fig. 13). Thus all the parts of a plant are brought back into a normal method of arrangement.

When it comes, however, to a consideration of the phyllotaxy of the plant, the question presents more difficulties. The first two leaves of each axis seem very much to be opposed to each other, the meeting of the basal edges of second leaf at the flower (instead of the buds defining the axil of the first leaf) alone suggesting that this opposition is more apparent than real. It will also be noticed that the spathe is turned in such a way as to suggest that its axis lies at a right angle to a line connecting the axils of the first and second leaves.* When a second spathe (fig. 12) occurs, it seems to fall almost above the axil of the first leaf (fig. 13). So that it has seemed reasonable to consider this a case of a one-third phyllotaxy. In that case we meet the difficulty of always finding the first leaf of each new axis not directly opposed to the subtending leaf, but a little to one side and always in a definite direction.

This could be explained by the assertion that it is not unusual in monocotyledons to find a slight lateral displacement of this first leaf, or by an equally valuable suggestion that the phyllotaxy may be far more complicated than here represented, but approaching the one-third arrangement. It seems, however, just as well to adopt the simpler view, especially since much displacement must necessarily take place in such a complicated structure as the apex of this crowded root stock.

* The folding of the edges of the spathe gives the appearance that the midrib of the same lies between the spadix and the rest of the plant, rather than to one side as more careful dissection would indicate.

Considering now the true flowers, no arrangement on the spadix consistent with the ordinary views of phyllotaxy can be made out. The flowers are arranged vertically along the axis of the spadix in such a way as to form diagonal rows. In one specimen at hand at present writing, there are nine rows of flowers passing diagonally around the axis in one direction, and nine in the other direction, forming thus eighteen vertical rows. These rows are apt to be more or less disturbed by lateral pressure, especially at the top of the spadix (fig. 11). In like manner, it will be noticed that the sepals enfold each other in every order possible on the same spadix, so that no conclusions can be drawn from their arrangement.

As to the seeds, there seem to be no radicles, the very first roots being thrust out from the central vascular parts of the ascending stem (figs. 3, 4). This continues to be the manner of production of all succeeding roots. In old rootstocks the vascular portion is yellowish in color; the surrounding parts are almost white. This white portion surrounds the bases of the roots, and is readily separable from the same, suggesting that it is only a pithy structure which has grown out from the more vascular parts of the rootstock, and which in its growth has more or less enfolded the roots. It will also be noticed that the roots are much wrinkled, suggesting a contraction of their length (fig. 5). Knowing that the seeds germinate usually within an inch of the surface of the ground, it has seemed reasonable that this was an arrangement to draw the rootstock, which otherwise would become ærial, down into the loose mud, each year's growth meaning a new grip on the plant, and a renewed hauling process back into the earth, which succeeds so well that the top of the rootstock as a rule is found at least several inches below the surface of the ground.

EXPLANATION OF PLATE LXXXII.

1. The lower part of a seed showing the depression, × ½.
2. A section across the upper part leaving the plumule, × ½.
3. The same, germinated, × ½.
4. A section of a young specimen, showing the origin of the first roots from the stem, × ½.
5. A plant, the earlier scales broken away to reveal the young flower, Feb. 15, × ¼. Also showing the wrinkled roots.

6, 7, 8. Various stages in the variations from scales to leaves in the same, × ½.

9. Scales and leaves removed, showing an aborted flower of the season.

10. The spadix taken from the same.

11. The spadix of a normal flower, × ½.

12. A spadix, the regular spathe broken away, revealing an abnormal second spathe at the base of the spadix.

13. The arrangement of two successive terminal stems of the plant, with their leaf appendages. The leaves are successively numbered, No. III. in each case signifying the spathe, the position of the second spathe being indicated in the first stem.

14, 15. Two methods of representing the arrangement of the plant as it might be expected to exist if the normal one third arrangement were adopted. In Fig. 15 No. II. should be on the second line, not the first.

16. The position of the "flowers" and leaf buds, irrespective of leaves or scales: *a*, *e*, *f* represent membranous aborted spathes; *b*, *c*, *d* represent the bases of the stalk supporting the flowers which arrive at perfection. The remaining flowers are also aborted, although it is barely possible that *l* or *m* are far enough along in the series to develop into mature flowers next season.

17. The same uncoiled and more graphically represented.

18. A vertical section of one of the true flowers while still in the bud, × 2.

The Fresh-water Algæ of Maine.—I.

By F. L. Harvey.

The species of Maine Algæ enumerated below were observed during the fall of 1887.

The gatherings were taken from sheltered coves and pot-holes along the Penobscot in the vicinity of Orono; also from the clear running water of spring brooks, and from Chemo Pond and stream five miles east of Orono. Quite a number of species were observed in the stagnant water of an old well on the college farm.

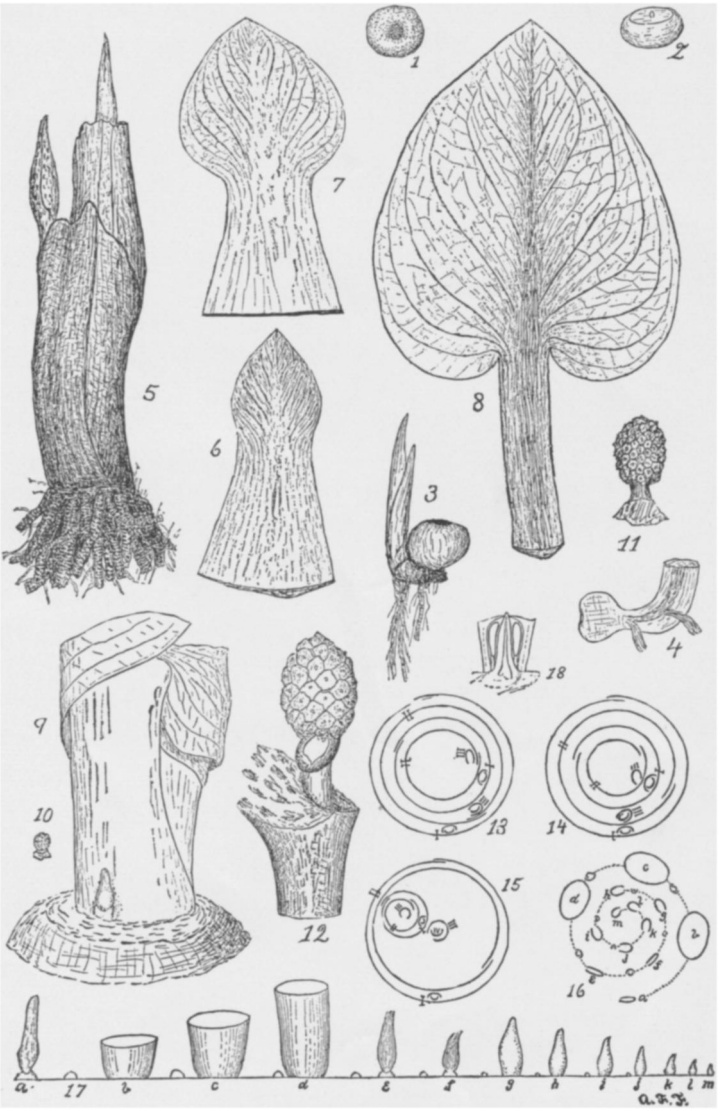
As no observations have before been published upon the fresh-water algæ of Maine, it is thought best to include, with the novelties, all the species observed, for the purpose of showing geographical distribution.

Descriptions are given of the new forms and those not observed before in the United States.

Some of the forms should be figured, but there are not enough to make a full plate, so it is thought best to defer the illustrations until more observations are made, and include them with others in another contribution.

The references to plates and figures are to Wolle's Desmids and Fresh-water Algæ of the United States. The systematic arrangement of the species is that given in the same works.

The writer is greatly obliged to Mr. Wolle for professional



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